Obituary: John Robert (Jack) Cunningham, O.C., B.Eng., M.Sc., Ph.D., FCCPM, FAAPM, FCOMP 1927–2020

FIG. 1. John Robert "Jack" Cunningham upon winning the Order of Canada in 2005. [Color figure can be viewed at wileyonlinelibrary.com]

The medical physics community has lost one of its great pioneers with the passing of John R. Cunningham O.C., B.Eng., M.Sc., Ph.D., FCCPM, FAAPM, FCOMP in Calgary, Alberta, Canada, where he lived most recently with his wife, Sheila Cunningham. He was known universally, simply as "Jack." He passed away on 04 January 2020, one day before his 93rd birthday, as a result of progression of prostate cancer.

Jack was born in Regina, Saskatchewan in 1927. He was immediately adopted by Elizabeth and Alexander Cunningham. Jack lived his younger years in Assiniboia, in the province of Saskatchewan in Canada.

Jack's first introduction to Medical Physics occurred during his undergraduate years when he was involved in the operation of a Radon Plant for the Saskatchewan Cancer Commission, Saskatoon, Saskatchewan, Canada between 1948 and 1950. In 1951, Jack received an M.Sc. degree under the supervision of Dr. Harold E. Johns working on electron range-energy relationships measured on an early version of a clinical betatron.[1] After a sojourn from Medical Physics for 7 years at the Grain Research Laboratory in Winnipeg, Manitoba, Jack obtained his Ph.D. in Physics at the University of Toronto in 1955 on polymer research using ultrasound techniques. He then worked for the Canadian Defense Research Board in Ottawa on issues related to "The Effects of Nuclear Weapons."

In 1958, Harold Johns enticed Jack to return to Medical Physics at the Ontario Cancer Institute (OCI)/Princess Margaret Hospital (PMH) in Toronto. Except for a leave of absence between 1964 and 1965, when he worked under the auspices of the International Atomic Energy Agency (IAEA) as an Advisor in Medical Physics and Radiation Protection to the government of Ceylon (now known as Sri Lanka), he continued to work at the OCI/PMH until 1989. From 1965 to 1989, he was the Chief of Clinical Physics. He also moved through the ranks of academic appointments in the Department of Medical Biophysics of the University of Toronto where he became a Full Professor.

Jack contributed significantly to the *genesis* of Canadian Medical Physics. In his early years at the OCI/PMH, Jack, in collaboration with Harold Johns, was heavily involved in the design of radiation therapy apparatus.[2–6] One of the first rotational cobalt-60 machines was designed and built in 1958.[4] In fact, this machine contained a diagnostic x-ray tube in its head for therapy verification — a concept that has been rejuvenated in recent years as "image-guided radiation therapy." In those days, conventional simulators were not yet commercially available so that this concept also provided pre-treatment simulation capabilities. Jack also developed a scanning beam technique for total body irradiation.[2] In 1962, Jack and Harold designed and built the world's first double-headed cobalt-60 machine[3] capable of delivering parallel-opposed fields, an innovative machine that could take partially decayed sources from any two of the other 8 or so cobalt machines at PMH and use them for another 5 years.

After 1989, Jack left OCI/PMH and became a consultant for a Canadian, Ottawa-based company (Theratronics, MDS Nordion) that was marketing software for radiation treatment planning, software that Jack originally developed throughout his career in Toronto. From the early 1960s, his major contribution was in radiation dose distribution calculations for cancer patients requiring radiation treatments.[7–10] His methods used differential scatter quantities, known as *scatter-air ratios*[9,11–13], and became widespread on commercial treatment planning workstations throughout the world. This was a breakthrough advance in dose accuracy that recognized the pivotal importance of splitting the total dose of an external beam of radiation into primary and secondary components, especially for irregular beam shapes and in the presence of tissue inhomogeneities as well as beam modifiers.[9,14–20] This methodology was also used to develop and evaluate various clinical treatment procedures.[13,21–25] This activity is also the reason why Jack has had a very significant involvement in many International Conferences on the Use of Computers in Radiotherapy (ICCR), especially the 1984 meeting held in Toronto, for which he served as the chairman.[26] The

development and application of his treatment planning programs has had a major impact on the dosimetric accuracy of radiation treatment for millions of cancer patients worldwide.

Jack Cunningham's global impact on the practice of Medical Physics can probably best be summarized by his publications which includes approximately 90 papers as well as the famous textbook he co-authored with Dr. H.E. Johns entitled *The Physics of Radiology*[27]— generally known as the "bible" of Medical Physics, last published in 1983. This book remains a classic text in our field. Jack was never one to publish too quickly, often considering his research and developmental work to just be part of the normal responsibility of a Medical Physicist.

Jack was a supervisor and mentor to a number of graduate students. Examples include: Louis Beaudoin, who performed tissue inhomogeneity corrections with differential scattering volumes for photon beams — a method that was very computer intensive and well-ahead of its time — likely the first voxel-based method;[28,29] Alan Rawlinson, who evaluated synchronous shielding for cobalt-60 teletherapy[30,31] — a concept that was a forerunner of intensity modulated radiation therapy; Jacques Niederer, who developed a sophisticated cell response model to fractionated doses of radiation, a model capable of describing most of the radiobiological functions that are commonly studied;[32] Marc Sontag, who developed the equivalent tissue-air ratio method for tissue inhomogeneity corrections in photon beams at a time when maps of patient-specific tissue density became available with the advent of x-ray computed tomography[17,33–35] — a method that accounted for the third dimension in dose calculations and was the most sophisticated clinical method available for a number of years as the field progressed from 2-D radiation therapy to 3-D conformal radiotherapy; Milton Woo, who then added the consideration of electronic disequilibrium in photon beam dose calculations[16,36] — providing yet another level of physics complexity to patient-related dose computations. Furthermore, Jack guided and mentored a number of visiting medical physicists from around the world resulting in precise measurements of tissue-air ratios,[12,37] new procedures for radiation treatment,[2,5,6] and dosimetry for beta sources.[38]

Jack has been very active in the national Medical Physics scene in Canada. He served twice as the Chair of the Division of Medical and Biological Physics of the Canadian Association of Physicists (the forerunner of the Canadian Organization of Medical Physicists, COMP). Internationally, Jack Cunningham served as the Canadian representative to the International Organization for Medical Physics (IOMP) and in the late 1980s served as its president.

Jack also had a significant influence on promoting the importance of Canadian science. In 1984, as a cost-saving measure, Prime Minister Mulroney's government decided to disband the radiation standards group at the National Research Council in Ottawa. Jack was interviewed on a national radio program called *Quirks and Quarks* and was asked about the impact of closing the Canadian radiation standards lab. As a result of this interview and the subsequent news media coverage and public reaction, the dosimetry group was promptly reinstated.

FIG. 2. Jack and Sheila Cunningham lunching at the AAPM Annual Meeting in San Diego in 2003. [Color figure can be viewed at wileyonlinelibrary.com]

Although Jack retired from the OCI/PMH in 1989, he remained active in the field, continuing to participate in scientific meetings and lecturing in the radiation physics course at the University of Alberta until very recent years. Jack continued to serve on multiple journal editorial boards and contributed to several major reports under the auspices of the International Commission on Radiation Units and Measurements (ICRU).[39,40] In the 1980s and 1990s, he participated in basic data generation for dose determination[41–47] as well as the development of dosimetry protocols including ICRU 24,[39] of which he was the chairman, and AAPM Task Group 21.[48]

The Canadian Organization of Medical Physicists established the *J.R. Cunningham Young Investigator Awards* to recognize his significant contributions to medical physics. The awards are presented to the top three speakers in the Young Investigators' Symposium held during the COMP's annual scientific meeting. The Symposium is widely recognised as one of the highlights of the annual meeting, with a quality of presentations that is of international calibre. Jack often served as honoree and co-chair of this symposium — an inspiration to newcomers in the field.

Jack's contributions to the scientific world have resulted in many visiting lectureships and honours from scientific organizations. One of the most prestigious is the Coolidge Award given by the American Association of Physicists in Medicine in 1988 recognizing his distinguished career in Medical Physics. In 2005, Jack received the Order of Canada, the top award given by the Canadian government for those "who exemplify citizenship and whose contribu- tions enrich the lives of their contemporaries." In 2006, Jack received the inaugural COMP Gold Medal, COMP's highest honour, recognizing his outstanding contributions

to the field of medical physics in Canada. Other awards include the Kirkby Award, a joint award of COMP and the Canadian Association of Physicists, recognizing his outstanding service to general Canadian physics, and the International Union for Physical and Engineering Sciences in Medicine (IUPESM) Award.

Even in his retirement years, Jack continued to serve unofficially as the friendly international diplomat of Canadian medical physics.

The above gives a brief glimpse of this outstanding individual in the context of his scientific and academic achievements. In addition to these achievements, however, Jack possessed a very outgoing, congenial and personable character, for which he is well-renowned by all those who have had personal contact with him. I (JVD), as one who has worked with him on a daily basis for over 18 years and have known him for over 48 years, can attest to this fact, a char- acteristic which is rare for an individual of his expertise and international stature. I (JJB) can state that Jack was an approachable and influential mentor and role model, illuminating my career path into radiation oncology physics. A further demonstration of his generosity is that his home was often offered as a temporary residence for new graduate students, international visitors and visiting professors. A further description of his personality and humour is well exemplified by the entertaining 300-page memoir that Jack wrote, entitled *And I Thought I Came From a Cabbage Patch!*[49]

Jack is survived by his wife of 68 years, Sheila, three daughters, Susan, Joan, and Karen and their partners and two sons, Ian and Clifton and their partners along with 9 grandchildren and 3 great-grandchildren. We in the Medical Physics community of Canada and beyond extend our sincere condolences to them.

Jack will be greatly missed, but his influence will live on.

Jacob (Jake) Van Dyk
Jerry J. Battista

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